CLAIMS

What is claimed is:

1. A system comprising:

a first control level having at least one level-1 controller for moving through a sequence of first level states, the first control level generating a first level command associated with one of the first level states; and

a second control level having a level-2 controller for moving through a sequence of second level states in response to the first level command and for sending a status report to the first control level when a level-2 condition that is defined in one of the second level states is fulfilled.

2. The system of claim 1, wherein the second control level comprises a plurality of level-2 controllers including the level-2 controller, and wherein the first level command is targeted to the level-2 controller.

3. The system of claim 1, wherein the level-1 controller tests a level-1 condition that is defined in one of the first level states, and moves from the one first level state to another of the first level states in response to the status report and the testing.

4. The system of claim 1, wherein at least one of the level-1 controller and the level-2 controller directly controls a system component by issuing the first level command or a second level command, respectively.

5. The system of claim 4 further comprising a third control level interfacing between the second control level and the system component, wherein the third control level is designed for receiving at least one of the first level command and the second level command and translating the received command for the system component.

6. The system of claim 1 further comprising a processor for generating a level-1 controller table containing parameters, wherein the level-1 controller identifies the first level

command associated with the one first level state by accessing the parameters in the level-1 controller table.

7. The system of claim 6 further comprising a user interface, wherein the parameters in the level-1 controller table are changeable by adjusting values in the user interface.

8. The system of claim 1, wherein the sequence of first level states comprises a plurality of sequences including the sequence, and wherein the level-1 controller selects, among the plurality of sequences, the sequence of first level states to move through in response to a host level command received from a host control level.

9. The system of claim 1 further comprising sample aspiration components, flow cell components, transport mechanisms, and image acquisition components for urinalysis, the second control level comprising:

a first level-2 controller for controlling the sample aspiration components, wherein the first level-2 controller is the level-2 controller;

a second level-2 controller for controlling the flow cell components;

a third level-2 controller for controlling the transport mechanisms associated with sampling; and

a fourth level-2 controller for controlling the image acquisition components.

10. The system of claim 9 further comprising a pump, a valve, and a motor, wherein the pump, the valve, and the motor are controlled by the first level-2 controller.

11. The system of claim 9 further comprising a processor for generating a level-2 controller table containing second level commands, wherein the first level-2 controller controls the sample aspiration components according to the level-2 controller table, and wherein the level-2 controller table is indexed by the second level states.

12. The system of claim 11, wherein the level-2 controller table indicates which of the second level states to move through in response to the first level command.

13. The system of claim 11, wherein the level-2 controller table comprises:

rows indexed by the second level states;

a first set of columns indicating the second level commands;

a second set of columns indicating status reports including the status report;

a third set of columns indicating level-2 tests for checking if level-2 conditions including the level-2 condition are fulfilled; and

a fourth set of columns indicating one of the second level states to move to, wherein the one second level state depends on results of the level-2 tests.

14. The system of claim 13 further comprising a processor for generating a level-1 controller table, wherein the level-1 controller table for the first control level substantially mirrors the level-2 controller table, the level-1 controller table comprising:

rows indexed by the first level states;

a first set of columns indicating first level commands including the first level command;

a second set of columns indicating status reports to be generated by the level-1 controller;

a third set of columns indicating level-1 tests for checking if level-1 conditions are fulfilled; and

a fourth set of columns indicating courses of action according to results of the tests.

15. The system of claim 9, wherein the first level-2 controller controls the sample aspiration components, wherein a subgroup of sample aspiration components are controlled by both the first and the second level-2 controllers.

16. The system of claim 9, wherein the flow cell comprise a valve and a pump for controlling flow of fluids.

17. The system of claim 9 further comprising a specimen rack for holding urinalysis samples, wherein the transport mechanisms comprise at least one of an arm, a motor, and a conveyor belt for transporting the specimen rack.

18. The system of claim 9 further comprising a processor for generating a level-2 controller table containing parameters, wherein the third level-2 controller controls the transport mechanisms according to the parameters in the level-2 controller table.

19. The system of claim 9, wherein the image acquisition components comprise a strobe bulb, a camera, and a motor.

20. The system of claim 1, wherein the level-1 controller, in response to a test result, performs one of the following:

proceeds from one of the first level states to another of the first level states;

proceeds to an idle state; and

generates an error signal depending on a result of a test.

21. The system of claim 20, wherein the test comprises obtaining a sensor reading and comparing the sensor reading to a reference value, and the result comprises relative magnitudes of the sensor reading and the reference value.

22. The system of claim 21 further comprising a nonvolatile memory containing the reference value, wherein the reference value is changeable by reprogramming of the nonvolatile memory.

23. The system of claim 21 further comprising a user interface, wherein the reference value is changeable through the user interface without overwriting a preprogrammed reference value.

controllers is for moving through a unique sequence of second level states in response to the first level command, wherein the plurality of level-2 controllers move through their respective sequences asynchronously with respect to each other, and wherein the level-1 controller completes a first level state in response to the plurality of level-2 controllers' completion of their respective sequences of second level states.

25. The system of claim 24, wherein the plurality of level-2 controllers directly or indirectly control a system component.

26. A method of executing a process, the method comprising:

identifying a sequence of first level states to move through;

issuing a first level command to a level-2 controller, wherein the first level command is associated with one of the first level states; and

receiving a status report from the level-2 controller, wherein the status report indicates a status of the level-2 controller in response to the first level command.

27. The method of claim 26 further comprising completing the one state and proceeding to another one of the first level states in response to the status report.

28. The method of claim 26, wherein the identifying of the sequence of first level states comprises accessing a sequence table for indicating which of the first level states are included in the sequence.

29. The method of claim 26 further comprising:

converting the first level command to a plurality of second level commands; and

forwarding the second level commands to a level-3 controller.

30. The method of claim 26, wherein the level-2 controller accesses a second level table to identify a relevant second level state and a second level command to be issued in the second level state, wherein the second level command is used to selectively control system components.

30. The method of claim 26, wherein the level-2 controller accesses a second level table to identify a relevant second level state and a second level command to be issued in the second level state, wherein the second level command is used to selectively control system components.

31. The method of claim 26, wherein the first level command directly or indirectly controls system components.

32. The method of claim 26 further comprising:

obtaining a sensor measurement to determine a parameter value;

comparing the parameter value to a reference value; and

moving from one of the first level states to another one of the first level states based on a relationship between the parameter value and the reference value.

33. The method of claim 26 further comprising moving from the one of the first level states to another one of the first level states after a predetermined time period in the one of the first level states.

34. The method of claim 26 further comprising issuing an error signal if the status report is not received within a predefined time period.

35. A method of controlling a system having controllers and system components, the method comprising:

receiving input parameters in a first language not readable by the controllers, wherein the input parameters are instructions for controlling the system components;

converting the input parameters into translated parameters that are in a second language, wherein the second language that is readable by the controllers; and

creating a table containing the input parameters and corresponding translated parameters, wherein the input parameters are editable in the table.

36. The method of claim 35, wherein the input parameters are inserted into the table through a user interface.

37. A system comprising:

a controller;

system components; and

a processor for generating a table for controlling the controller and the system components, the table comprising:

a first set of columns containing instructions in a first language that is not readable by the controller; and

a second set of columns containing instructions in a second language that is readable by the controller, wherein the instructions in the second set of columns are translated versions of the instructions in the first set of columns generated according to a program.

38. A system comprising a level-1 controller that divides a level-1 task into a first level-2 task and a second level-2 task and issues a first level command to a first level-2 controller and a second level-2 controller, respectively, wherein the first level-2 controller executes the first level-2 task and the second level-2 controller executes the second level-2 task in response to the first level command, so that once the first and the second level-2 controllers complete their level-2 tasks, the level-1 task is completed.

39. A multi-layered control system comprising:

a plurality of controllers in different control levels, each controller behaving according to a controller table containing a unique set of values, wherein each controller table is indexed by states and includes:

a first column of commands to issue to a lower level controller;

a second column of status reports to send to a higher level controller;

a third column of tests for checking whether a predefined condition is fulfilled; and

a fourth column defining a course of action if the predefined condition is fulfilled; and

an interface control level that receives commands from the plurality of controllers and controls system components in response to the commands.

5